JRC Scientific and Technical Reports

Waste Management and Solid Recovered Fuel Potential in the Enlarged European Union

Larnaca (Cyprus), June 20-23, 2006 – Conference proceedings

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Local event: waste management problems and solution in Cyprus

Dedicated lectures by QUOVADIS Stakeholders

General aspect related to solid and hazardous waste management strategy in Cyprus

Presented by
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Evironment sevice, Ministry of Agriculture, Natural Resources and Environment, Republic of Cyprus

GENERAL ASPECT RELATED TO SOLID AND HAZARDOUS WASTE MANAGEMENT STRATEGY IN CYPRUS

Michalis Constandinides

Environment Service

Larnaca 22.6.2006

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General comments:

- **Management of Solid and Hazardous waste : Necessity and priority**

- **Strategic Plan for the Waste Mgt**

1. **Waste producer**
2. **Waste treatment system**
3. **Waste regulators (administrations)**

2

GENERAL ASPECT RELATED TO SOLID AND HAZARDOUS WASTE MANAGEMENT STRATEGY IN CYPRUS

The Strategic Plan for the Management of Solid and Hazardous Waste was the result of a study covering, among others, the following elements:

- **Cyprus and EU legislation**
- **Classification of solid waste**
- **Targets**
- **Existing situation**
- **Technologies, methods and procedures**
- **Sources of waste**
- **Description of special waste**
- **Reuse, recycling and recovery**

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GENERAL ASPECT RELATED TO SOLID AND HAZARDOUS WASTE MANAGEMENT STRATEGY IN CYPRUS

General comments:

- **Waste management is the most problematic area for the adoption of the environmental acquis communautaire.**

- **Reasons :**

1. **high consumption patterns (over 600 Kg/ca/year),**
2. **limit of human resources in the governmental level**
3. **weaknesses in local administration,**
4. **absence of recycling systems,**
5. **not properly run landfill sites.**

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GENERAL ASPECT RELATED TO SOLID AND HAZARDOUS WASTE MANAGEMENT STRATEGY IN CYPRUS

CURRENT SITUATION

1. **MSW management is under the Municipalities Law**
2. **Recycling exists at a rate of appr. 3%**
3. **There are 6 official landfills, none of which complies fully with the Landfill of Waste Directive 99/31/EC**
4. **Only one complies fully**
5. **Uncontrolled disposal takes place in rural areas**
6. **There is no waste sorting at source**

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GENERAL ASPECT RELATED TO SOLID AND HAZARDOUS WASTE MANAGEMENT STRATEGY IN CYPRUS

MEASURES TAKEN ON THE STRATEGIC LEVEL

Municipal solid waste:

- **Main proposal of the Strategic Plan is the creation of 4 Regional Centres for MSW management**

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MEASURES TAKEN ON THE STRATEGIC LEVEL

- **Hazardous waste:**
- **A treatment unit is proposed, covering the needs for storage, sorting, classification, neutralization, controlled disposal of sludge, exporting, etc**
- **The design study is under execution**

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MEASURES TAKEN ON THE LEGISLATIVE LEVEL
There are already in place:

- **Solid and Hazardous Waste Law**
- **The Law on Packaging and Packaging Waste**
- **End-of-Life Vehicles, IPPC, Asbestos, Municipal waste incineration, Shipment of waste, etc**
- **Regulations: Used oils, Use of sludge, Batteries and accumulators, PCB´s/PCT´s, Landfill Sites, Producers' Responsibility, Inspector's duties, etc, etc**

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MEASURES TAKEN ON THE LEGISLATIVE LEVEL

There are already in place:

- **Ministerial Orders for:**

1. **Waste List**
2. **Waste Registry**
3. **Identification of Dangerous Waste**
4. **Application for Waste Management License**

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Ongoing measures for Paphos District

1. **The organisation of the Regional Centre for waste management is under way**
2. **The landfill is already in operation**
3. **A transfer station is under construction**
4. **Tender procedures are in progress for a sorting plant, and treatment of the biodegradable fraction**

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Ongoing measures for Larnaca/Ammohostos Districts

The construction of the landfill, two transfer stations, a sorting plant, and treatment of the biodegradable fraction (composting) is expected to start this summer.

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Ongoing measures for Lefkosia District

- **Upgrade the major existing landfill of Kotsiatis serving almost 275.000 population**
  - **Main target is to have a state of the art organised Regional Centre, comprising of a landfill, a sorting plant, and treatment of the biodegradable fraction**
  - **The project is expected to operate by end 2008**

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GENERAL ASPECT RELATED TO SOLID AND HAZARDOUS WASTE MANAGEMENT STRATEGY IN CYPRUS

Ongoing measures for Limassol District

- **Upgrade the major existing landfill of Vati serving almost 250.000 population**
- **Main target is to have a state of the art organised Regional Centre, comprising of a landfill, a sorting plant, and treatment of the biodegradable fraction**
- **The works are expected to operate by end 2008**

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GENERAL ASPECT RELATED TO SOLID AND HAZARDOUS WASTE MANAGEMENT STRATEGY IN CYPRUS

Ongoing measures in general

- **Updating the Strategic Plan**
- **Procedures already initiated to close down uncontrolled landfills and restore them (~100)**
- **A LIFE program dealing with:**

1. **End-of life vehicles**
2. **Construction and demolition waste**
3. **Electrical and electronic equipment waste**

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Ongoing measures

- **Further studies on waste are under implementation:**
1. **Asbestos waste management**
2. **Construction and demolition waste in all districts**
3. **Plastic bags**

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NECESSARY INSTITUTIONAL CHANGES EXPECTED TO BE DONE

- **ESTABLISHMENT OF AN ENVIRONMENT AGENCY AND INSPECTORATE**

- **ESTABLISHMENT OF AN ENVIRONMENTAL TECHNOLOGY AND RESEARCH INSTITUTE**

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Main challenge remain

- **LAWS AND REGULATIONS IS ONE PART OF THE STORY**
- **BUT, THE MOST IMPORTANT THING IS THE ENFORCEMENT AND IMPLEMENTATION!!**

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Hazardous waste management in Cyprus

Presented by
Meropi Samara Miliotou

Environment Service – Ministry of Agriculture, Natural Resources and Environment, Republic of Cyprus

HAZARDOUS WASTE MANAGEMENT IN THE REPUBLIC OF CYPRUS

Meropi Samara Miliotou
Environment Service
Ministry of Agriculture, Natural Resources and Environment

June 2006

Current Legislation

- **The solid and Hazardous Waste Law – 215(I)/2002**
  - harmonization with the EU legislation on:
    - Directive 75/442/EC on waste and its amendments
    - Directive 91/689/EC on hazardous waste and its amendments
    - Regulation 259/93/EC on the supervision and control of shipments of waste within, into and out of the EC

- **Regulations under the law**:
  - 82/2003: transposition of directive 91/157/EEC on batteries and accumulators containing certain dangerous substances
  - 636/2002: transposition of directive 96/59/EC on the disposal of PCB/PCT
  - 637/2002: transposition of 75/439/EEC on the disposal of waste oils and 2000/76/EC on the incineration of waste
  - 668/2004: transposition of directive 2002/96/EC on WEEE management and of 2002/95/EC (RoHS) directive on the restriction of certain hazardous substances on EEE

- Ministerial Orders under the law:
  - 157/2003: transposing decision 200/532/EC on the list of waste and hazardous waste

The solid and Hazardous Waste Law – 215(I)/2002

- Competent Authority:
  - The Minister of Agriculture, Natural Resources and Environment and for certain waste streams the Minister of Interior

The solid and Hazardous Waste Law – 215(I)/2002

- **Part I Introductory provisions**
- **Part II Management of Solid Waste**
- **Part III Provisions especially for the management of hazardous waste**
- **Part IV Transboundary movement of waste**
- **Part V Administration and implementation**
- **Part VI Additional provisions**

The solid and Hazardous Waste Law – 215(I)/2002 – part III Hazardous waste

Provisions for the management of hazardous waste

Permit on hazardous waste management

Every establishment and undertaking –

- **which collects or transports hazardous waste,**
- **which arranges for the disposal or recovery of hazardous waste on behalf of others (dealers or brokers),**
- **which carries out the operations referred to in the Annex IIA or IIB of the law for hazardous waste, and**
- **which carrying out its own hazardous waste disposal at the place of production,**

Must obtain a permit for the management of hazardous waste, before the beginning of its operations.

The solid and Hazardous Waste Law – 215(I)/2002 – part III Hazardous waste

The permit includes terms and conditions that monitor at least the following:

- **the types and quantities of waste to be managed**
- **the technical requirements regarding packaging and labelling in the course of collection, transport and temporary storage,**
- **the collection, transport, temporary storage and treatment or disposal method of the waste**
- **the technical requirements of the treatment plant/ disposal site**
- **The security precautions to be taken**

The solid and Hazardous Waste Law – 215(I)/2002 – part III Hazardous waste

Hazardous Waste Registry

- Every producer or owner of hazardous waste or a licensed establishment or undetaking shall:

- Keep a record of the quantity, nature, origin, the destination, frequency of collection, mode of transport and treatment method in respect to the waste and the operation used ·

- Make this record available to the Competent Authority every February of each year and on request.

- Keep approval documents of the execution of the operations according to the permit granted .

The solid and Hazardous Waste Law – 215(I)/2002 –Hazardous waste

MEASURES TAKEN ON THE STRATEGIC LEVEL

- The Strategic Plan for the Management of Solid and Hazardous Waste has been approved by the Council of Ministers

- It provides all the tools and ways for an integrated management of all the waste streams

The solid and Hazardous Waste Law – 215(I)/2002 –Hazardous waste

The Strategic Plan for the Management of Solid and Hazardous Waste was the result of a study covering, among others, the following elements:

- **Analysis of the Cyprus and EU legislation waste mgt**
- **Classification of solid waste according to the European waste list**
- **Definition of targets**
- **Existing situation**
- **Technologies, methods and procedures**
- **Sources of waste**
- **Description of special waste**
- **Analysis of targets concerning reuse, recycling and recovery**

The solid and Hazardous Waste Law – 215(I)/2002 – Hazardous waste

MEASURES TAKEN ON THE STRATEGIC LEVEL

- **Hazardous waste:**
- **A treatment unit is proposed, covering the needs for storage, sorting, classification, neutralization, controlled disposal of sludge, exporting, etc**
- **The design study is under execution**

Existing Management Systems

· collection and storage of PCB containing oil from transformers and capacitors

· sterilization of hospital waste

· collection of waste water and sludge in CWWTP in Ypsonas and Vathia Gonia

· Incineration of slaughterhouse waste and oil sludge from the oil-refinery in cement kilns

· collection and export of laboratory solvents (about 10 m^3/y) etc

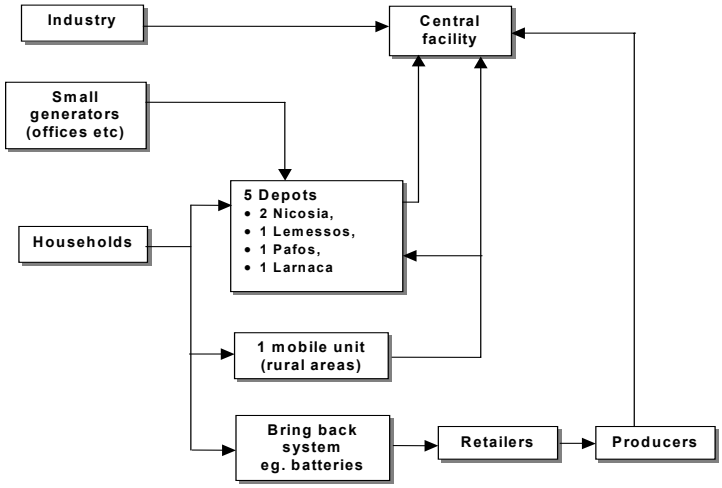
· collection of lead acid batteries and export of lead waste

· collection and recycling of used motor oil

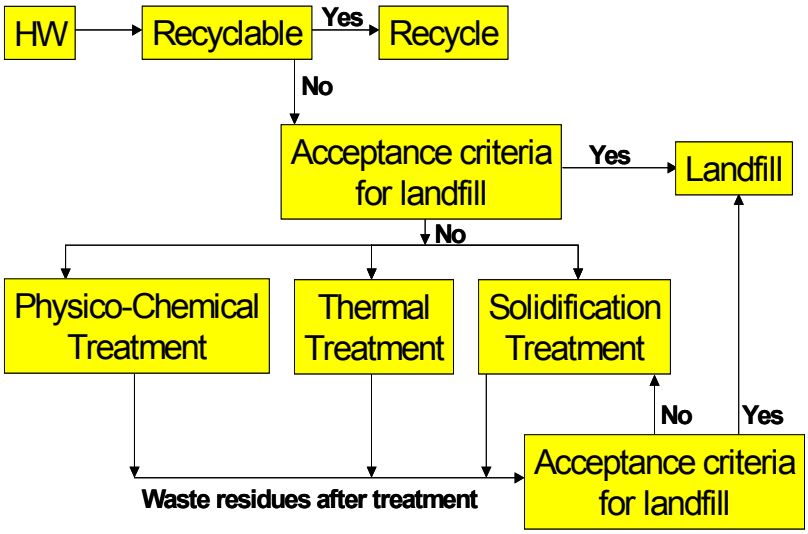
PROPOSED MANAGEMENT SYSTEM IN CYPRUS

COLLECTION SYSTEM – HAZARDOUS WASTE MANAGEMENT CENTER

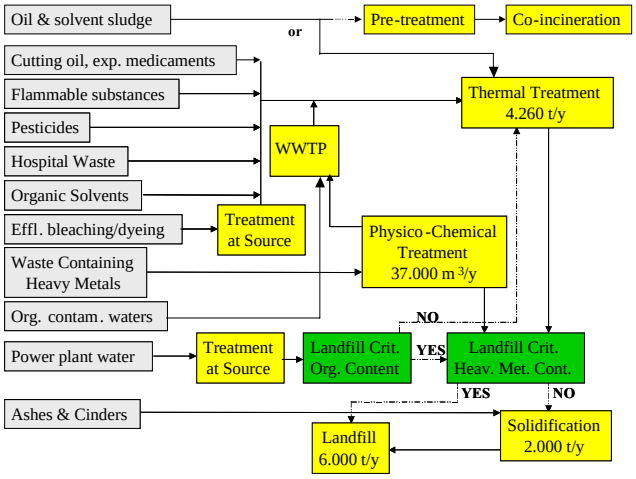
Proposed Collection System



Criteria for HW Treatment Selection



Establishment of HW Treatment Flow



HW MANAGEMENT CENTER

TRANSPORT - SORTING – STORAGE

PHYSICAL – CHEMICAL TREATMENT

THERMAL TREATMENT

STABILIZATION

LANDFILLING

SUPPORT SERVICES

Ongoing measures in general

- **Updating the Strategic Plan**
- **Procedures already initiated to close down uncontrolled landfills and restore them (~100)**

Ongoing measures

- **A LIFE program is in progress dealing with:**

1. **End-of life vehicles**
2. **Construction and demolition waste**
3. **Electrical and electronic equipment waste**

Ongoing measures (indicative)

- **Further studies on waste are under implementation:**

1. **Asbestos waste management**
2. **Construction and demolition waste in all districts**
3. **Plastic bags**

SRF: an important contribution to achieving environmental and energy-related goals

Presented by Joop van Tubergen *ERFO – European Recovered Fuels Organization*	

SRF

achieving environmental and energy-related goals

Overview of presentation

- **ERFO**
- **Definition of SRF**
- **Examples of production and use**
- **Environmental/ energy topics**
- **Conclusions**

ERFO

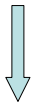
- European Recovered Fuel Organisation
- A non profit association
- Purpose
  - Represent European companies which produce fuels prepared from non-hazardous waste
  - Promote the use of such recovered fuels within the frame of sustainable development
  - Help establish high quality standards for such fuels at European level

ERFO'S MEMBERS

- AVR-Afvalverwerking
- CBR
- Essent Milieu
- Heraholding
- Veolia
- Albra
- Pirelli & C. Ambiente
- Pirkanmaan Jätehuolto Oy Tampere
- Remondis
- Scoribel/Holcim
- Sistema ECODECO
- SITA Belgium
- Shanks Nederland
- Van Gansewinkel Nederland

ERFO's Focus on standards

- Recovered fuels must gain public acceptance, trust and confidence
- Public trust is only possible if the conditions for preparation, transport and use of recovered fuels are stringent, transparent and easily controllable
- Standardisation is a must



- Solid Recovered Fuels (SRF)

ERFO'S INVOLVEMENT

- SRF standardisation work within CEN / TC 343 e.g. report on classification of SRF
- Participation in R&D programs
  - Pre-normative research on sampling, sample preparation and determination of biomass content
  - QUOVADIS : validation of Technical Specifications, Quality Management system and perspectives in new EU countries
- Participation in debates, works and lobbying activities related to SRFs
- Main contribution to the SRF chapter of the Bref Waste Treatment

ERFO'S VIEWS ON PENDING ISSUES FOR SRF

- SRF must be distinguished from other waste derived fuels; declaration of conformity should be a minimum requirement
- SRF should be qualified
  - as as specific (non hazardous) entry on the European Waste Catalog
  - as as specific entry on the green list of waste
- SRF name / qualification should be protected

Definition of SRF

- Solid fuel prepared from non-hazardous waste, meeting the classification and specification requirements of prCEN15359
- Prepared means processed, homogenised and up-graded to a quality that can be traded amongst producers and users

Examples of production plants

- **Paper/plastic fraction:**
  Essent Milieu, VAGRON Groningen

- **Solid recovered fuel (SRF):**
  Veolia, Haraldrud Oslo
  Remondis, VZEK Erftstadt

Production location VAGRON (Groningen)

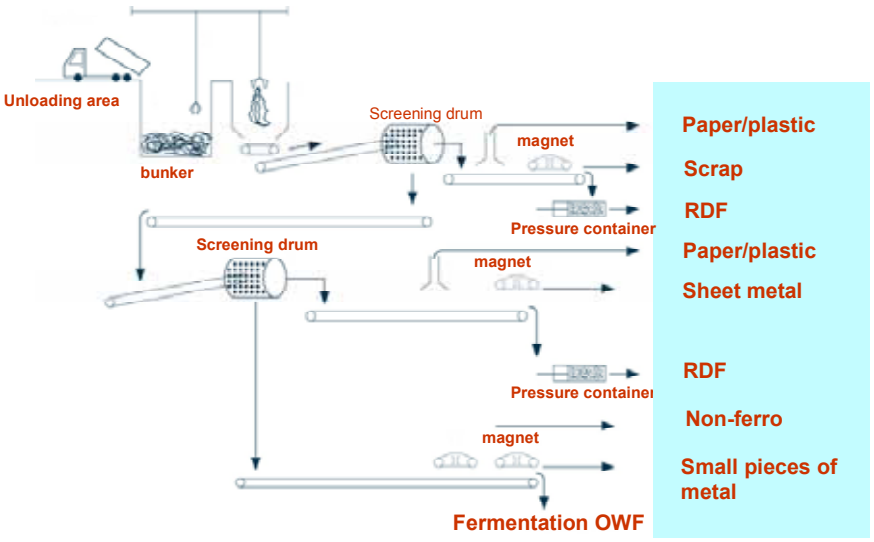
In this mechanical separation installation 230kt/a of household and commercial waste is separated into different fractions. One of these is 30kt/a paper/plastic fraction, which is used for secondary fuel. The remainder is converted into energy in this plant.

Production location VAGRON (Groningen)

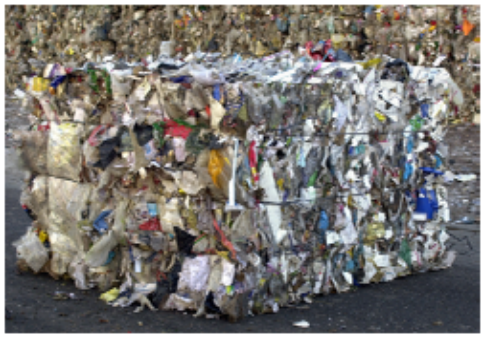
Screening drums separate the waste.

Air classifiers separate a paper/ plastic fraction.

Process diagram VAGRON (Groningen)



Production locations Vagron and Wijster



The pressed bales of paper/plastic fraction.

Bales ready for transport.

Veolia

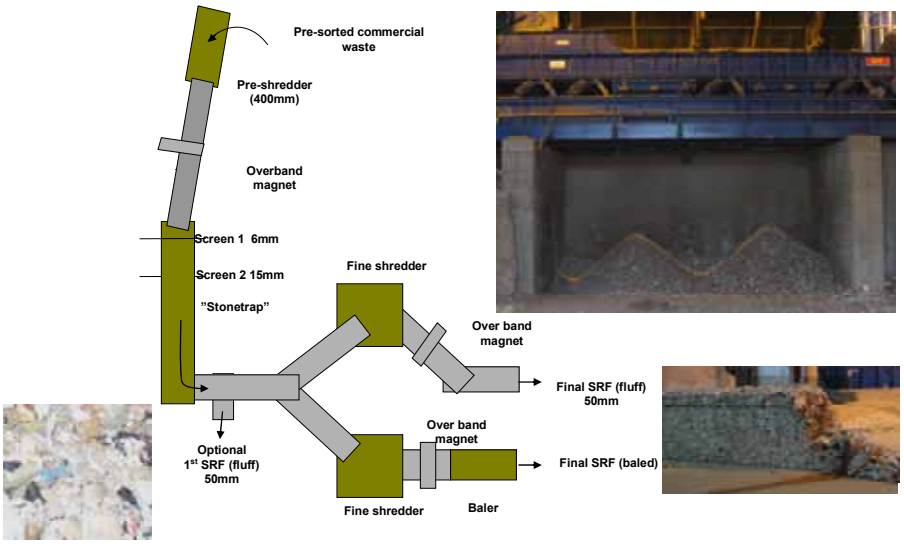
Haraldrud Oslo

Recherche & Développement

General information

- 50kt/a of industrial/commercial waste treated at Haraldrud representing between 5,000 and 6,000 customers
- 30kt/a of SRF produced per year
- 20kt/a residual fraction: recycled (5% metals), landfilled (20% inert fraction), humidity losses (15%)
- Type of SRF : fluff and baled SRF
- Client: VIKEN Fjernvarme AS for district heating (Circulating Fluidised Bed of 30 MW, compliance with WID)

The tipping area



Quality control

Currently:

- **ISO 9001:2000**
- **Based on operator experience for pre-sorting of unsuitable material.**
- **On-site laboratory with adapted sampling and sample reduction procedure (pre-normative research project - TAUW/NOVEM/ERFO download www.erfo.info).**
- **Additional chemical and physical properties analysis carried out externally.**

Under progress :

- **Implementation of a QMS based on future CEN standards (QUOVADIS project).**

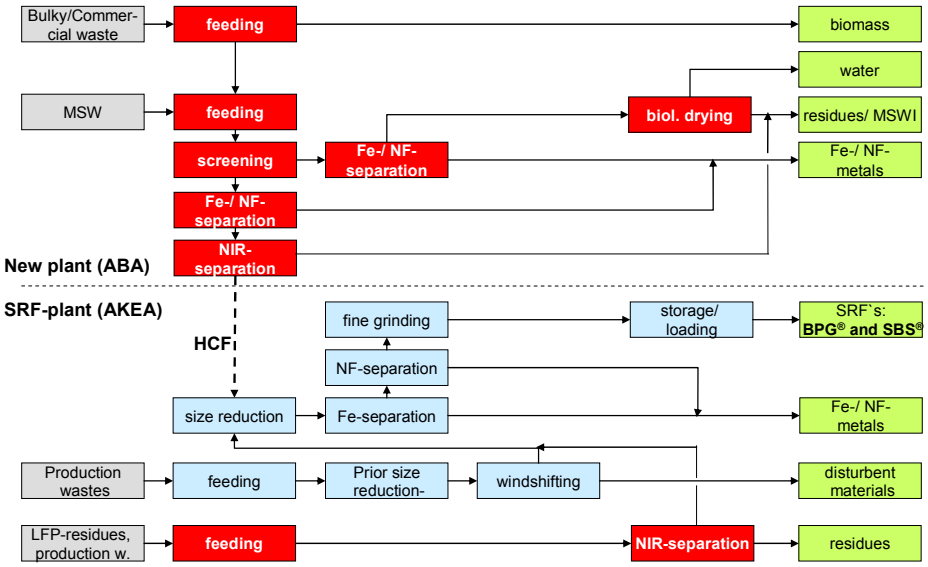
Remondis

VZEK, Erftstadt

General information

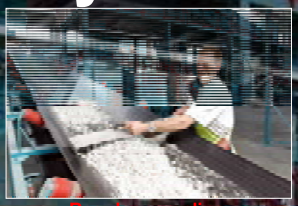
- 200kt/a wastes (50% MSW) treated at VZEKplant, Erftstadt
- 80kt/a of SRF produced
- Type of SRF : soft pellets
- Clients: cement industry, powerplants

Waste treatment center VZEK, Remondis



Quality control

Sampling behind last step of size reduction



Regular sampling during production
Analysis of H2O in the plant

Single samples are combined to 500-t-mixed-samples....

Delivery to the customer

Every 1.500 t the following parameters are analysed:

imat uve

Analyseprotokoll - Nr. 08 17
1.500t-analysis
for BPG® and SBS®
Parameter:
ds, H_2O, Cl, Ash, NCV + F
HM Group I-III:
As, Be, Cd, Co, Cu, Hg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Te, Tl, V, Zn
Ash:
Al_2O_3, CaO, Fe_2O_3, K_2O, MgO, Na_2O, P_2O_5, SiO_2, SO_3, TiO_2, ZnO

... and are analysed by an external laboratory :

imat uve

Analyseprotokoll - Nr. 08 15
500t-analysis
for BPG® and SBS ®
Parameter:
ds, H_2O, Cl, Ash, NCV
+ 2 HM (changing monthly)

Storage for BPG® and SBS®

Examples of users

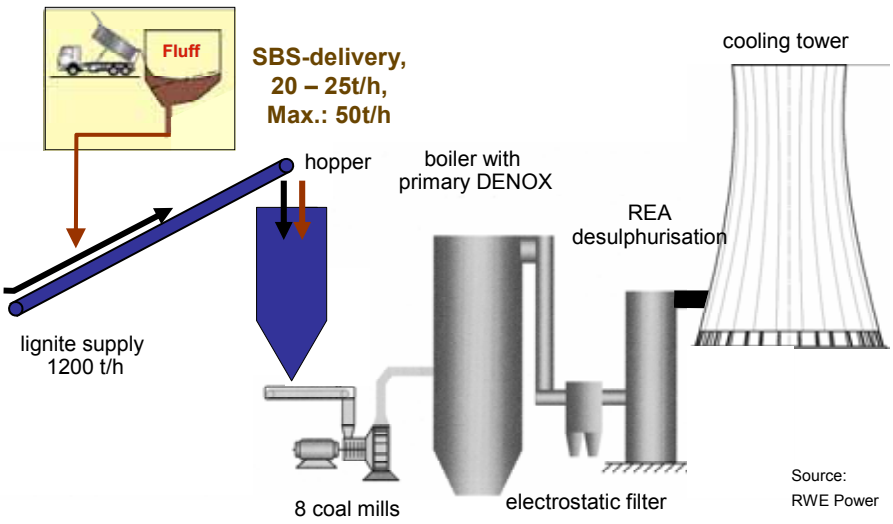
- **Hard coal, RWE Gerstein, 220kt/a**
- **Lignite, Vattenfall Jänschwalde, 400kt/a**
- **Lignite, RWE Berrenrath, 70kt/a**
- **Cementkiln, many plants current practice 900-1200kta in Germany**
- **CHP, Neumünster, 150 kt/a**

Project RECOFUEL

main issues of the partners

	• Remondis	SRF-production + coordination
	• RWE Power	large-scale demonstration co-combustion
	• University Stuttgart	lab tests + simulation
	• INFA	balances of SRF-production
	• KEMA	ash properties + corrosion
	• TAUW	quality control in the power plant
	• CESI	corrosion
	• Åbo Akademi Process	SFR properties + ash
	• University of Athens	combustion model
	• VINCA	mill measurements
	• ESSENT	technology transfer
	• PPC	technology transfer

Co-combustion of SBS®
in lignite-PC-boilers



Source:
RWE Power

Evaluation of SBS®-co-incineration
in Weisweiler

- quality of SRF (SBS®)
- delivery and transfer
- feeding and dosing
- combustion behaviour (ignition and burnout)
- fixing of heavy metals etc. in ash and gypsum
- flue gas cleaning system
- emissions according 17. BImSchV (WID)
- landfilling characteristics of combustion residues

Co-incineration of SBS® in lignite power plants is technically and environmentally feasible

Source:
RWE Power

SRF fired industrial boilers in Germany, operational

location	system	fuel	Capacity kt/a	H or P	user	note
Amsdorf	grate	HCF	60	H P	Romonta	enlargement
Bremen	grate	HCF	60	H P	Wool industry	retrofit
Minden	grate	HCF,CW	35	H	BASF Pharma	
Neumünster	CFB	HCF	150	H P	Industry, city	Replacement coalfired boiler
Premnitz	CFB	HCF,CW	100	H	Industry	Replacement oil/gas fired boiler

HCF: high calorific fraction from MBT plants
CW: commercial waste

SRF fired industrial boilers in Germany, planned

location	system	fuel	Capacity kt/a	H or P	user	note
Hamburg	grate	HCF	750	P	industry	Norddeutsche Affinerie
Heringen	grate	HCF	270	H	K+S	Replacement gas fired boiler
Hürth	grate	HCF	240	H P	industry	enlargement
Premnitz	CFB	HCF, CW	130	H P	Industry, city	
Rüdersdorf	grate	HCF	200	P	cementkiln	
Rudolstadt	grate	PR+ HCF	46+14	H	industry	a.o. papermill
Schwedt	CFB	PR+HCF	200+200	H P	papermill	
Stavenhagen	grate	HCF	90	H P	Pfanni	
Witzenhausen	CFB	PR+HCF	50+250	H P	papermill	Replacement oil fired boiler

HCF: high calorific fractions from MBT plants
CW: commercial waste
PR: paper rejects

Overview production and use

Overview SRF Production 2005	Plants Number	SRF kt/a	Cement kt/a	Power plant hard coal kt/a	Power plant lignite kt/a	CHP kt/a	MSWI kt/a	Blast furnace kt/a	Export kt/a
Austria	13	680	150	0	0	510	20	220	80-100
Belgium	5	100	100						-?
Denmark	1	12							0
Finland	21	300				300			0
France	0	0	50						-50
Germany	29	1700-2200	900-1200	500-600	See hardcoal	200-300			50-100
Greece	9	200	200?						0
Italy	49	1000	180	50	0	40	400		0
Netherlands	8	300-400	0	0	0	0	0		300-400
Portugal	3	?							0
Spain	0	0							0
Sweden	12	?				1300?			-?
UK	4	100	100						0
total		4000-5000							

SRF derived from HCF of MSW, bulky waste, mixed commercial waste and from production specific wastes

Marketpotential EU15

- Cement 15-30% substitution: **3,5-7 mio t/a**
- Power 2-4% substitution: **6,5-13 mio t/a**
- CHP ind.boilers,12% of combustible waste (ref. Germany, Netherlands): **17mio t/a**

- Total potential EU15: **27-37 mio t/a**

SRF derived from HCF of MSW, bulky waste, mixed commercial waste and from production specific wastes

Environmental/energy topics

- Environmental, emissions
- Energy and CO_2

Environmental goals

- Landfill directive, reduction of biodegradable component of waste by 65% in 2016
- Waste incineration directive, limits on emissions from incineration and co-incineration (cementkilns and coal fired powerplants) 2005

Energy-related goals

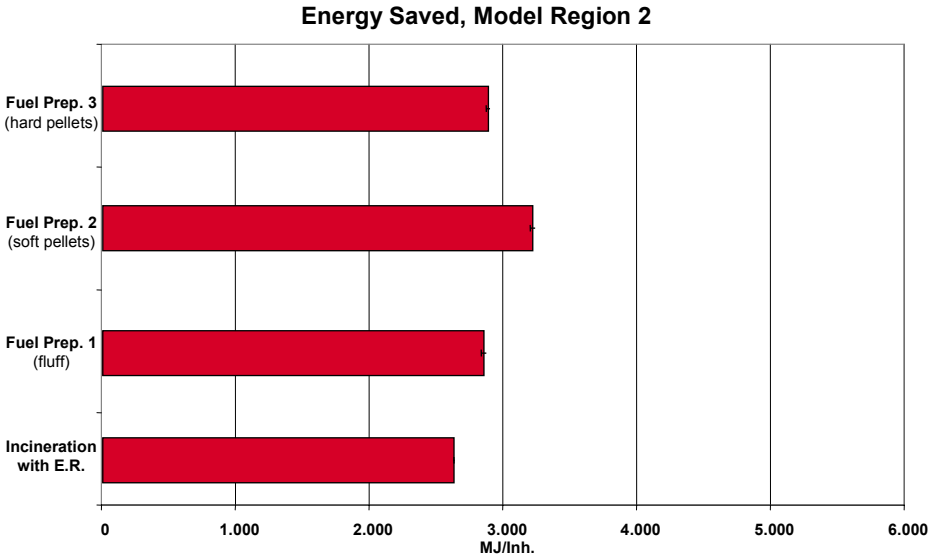
- **Directive 2001 RES , increase share of RES to 12% by 2010**
- **Kyoto protocol 1997, reduction of greenhouse gas**
- **Biomass action plan, increase the use of biomass for heating and cooling**

Cost benefit analysis

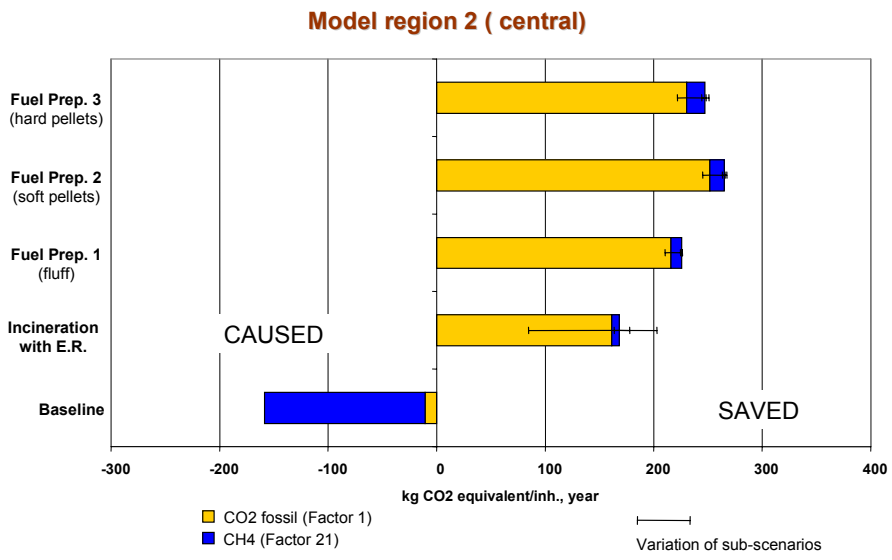
	Model region 1 "South"	Model region 2 "Central"	Model region 3 "North"
MSW generation [kg/Inh]	300	350	400
MSW composition	high organic, low packaging	medium organic and packaging	low organic, high packaging
separate collection system	glass, paper, bio-waste (low efficiency)	glass, paper, metals, plastics, bio-waste (high efficiency)	glass, paper, metals, bio-waste (medium efficiency)
cost level (personnel cost, investment cost)	low	medium	high
saleability of energy generated in a MSW incinerator	no heat saleable electric efficiency: 25% thermal efficiency: 0%	heat saleable during the whole year electric efficiency: 10% thermal efficiency: 70%	heat saleable during the whole year electric efficiency: 20% thermal efficiency: 80%

Download: www.gua-group.com :highlights, waste to recovered fuel

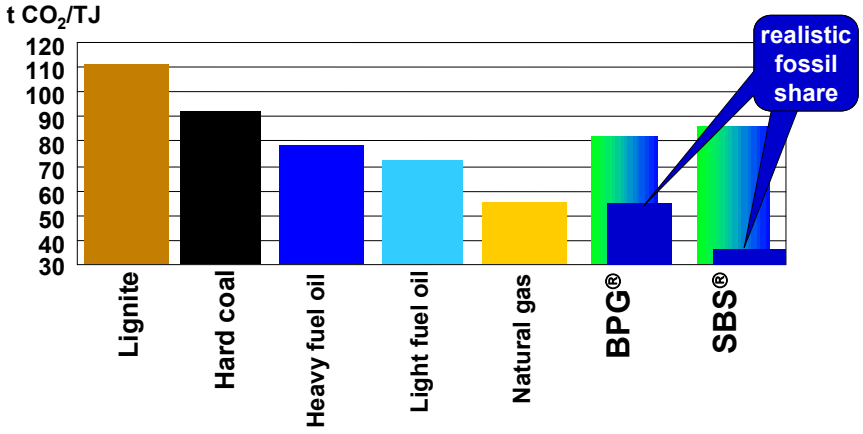
Results, Energy Saved



CO_2 reduction



Energy specific CO_2-emissions
of different fuels



Source:
REMONDIS

Conclusions

- SRF is a waste derived fuel of which properties can be guaranteed
- Market for SRF is developing, there is a strong growth in the CHP sector
- SRF of Hg class 1 and 2 can be used in most co-incineration plants (concerning environmental aspects)
- The use of SRF will contribute to the reduction of energy imports
- SRF constitute particularly a valuable solution to treat those waste fractions, which cannot be easily recycled
- The use of SRF fuels will contribute to the reduction of CO_2 emissions
- SRF constitute a high share of renewable source of energy

Demands on Solid Recovered Fuel for a low contribution to environmental pollution

Presented by ChristianTebert *ECOS – European Environmental Citizens Organisation for Standardisations / ÖKOPOL Expert contracted by ECOS for CEN-Technical Committee 343*	

Demands on Solid Recovered Fuel for a low contribution to environmental pollution

Position of

ECOS - European Environmental Citizens Organisation for Standardisations

Institute for Environmental Strategies

Presented by: Christian Tebert, ÖKOPOL
Expert contracted by ECOS for CEN-Technical Committee 343

Workshop Cyprus, 2006-06-22

Who is ECOS?

- European Environmental Citizens Organisation for Standardisation;
- Non-profit Association, established in 2002, secretariat based in Brussels;
- funded by the European Commission;
- status of an Associate Member of CEN;
- Members: Environmental protection NGOs working on European and national level;
- http://www.ecostandard.org

Aims of ECOS in the field of strategies on waste

- Promote the **prevention principle** of the waste hierarchy:
  => Minimisation of waste by prevention at source
- Promote a high level of **resource management**:
  => Closing the loop: return materials to recycling
- Promote **reduction of pollutants** of the waste
  => Separation of wastes containing heavy metals
- Promote a safe and sustainable disposal

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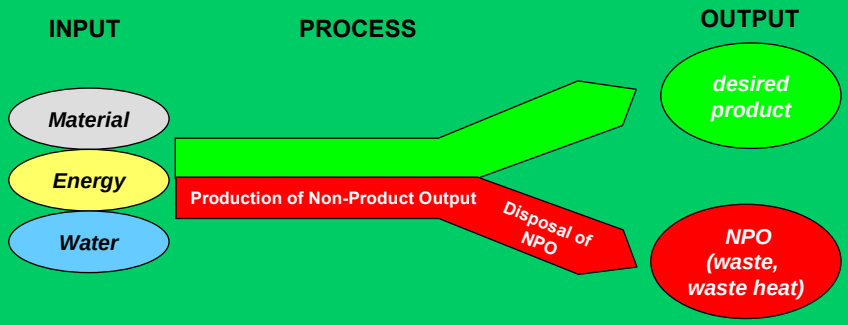
Institute for Environmental Strategies

Benefit of prevention

- **Disposal cost is the least cost originated from waste:**



Purchasing costs + **Storage+handling costs** + **Disposal costs** = **Overall costs of NPO**

= 10-30% of the turnover !

➢ **Transparency of costs leads to cost reduction**

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Position on Solid Recovered Fuel (SRF)

- Conditions to start SRF production:
  => strategies on waste **prevention** at source have been established in companies
  => systems for **separate collection of hazardous** substances are installed
  => material **recycling systems** have been assessed / successfully implemented
  => use of waste as fuel leads to similar or **less pollution** than without SRF use

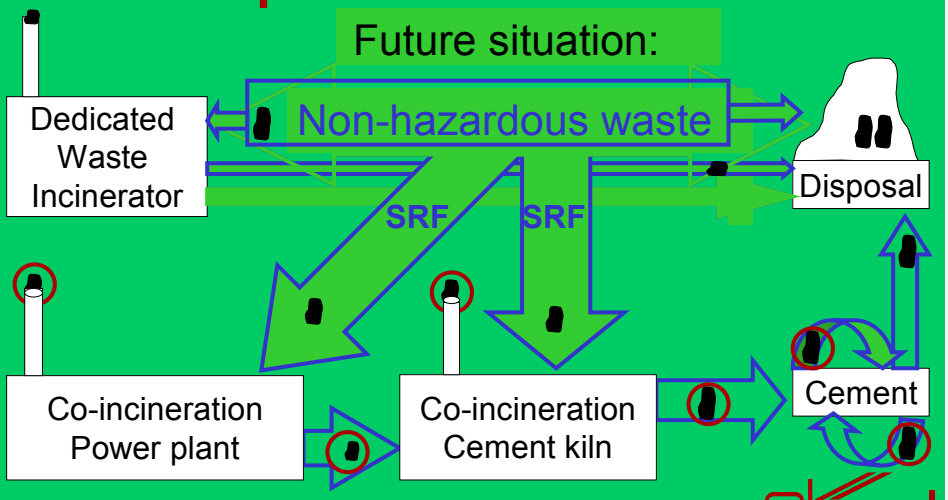
Concerning SRF: What is a high level of environmental protection?

Products shall make
"no contribution or the smallest possible contribution
to increasing the amount or harmfulness of waste and pollution hazards" (Waste Framework Directive)

⇒ The use of SRF may not increase
- pollution hazards in air emissions
- pollution hazards in (by-)products

} Pollu-tants to sinks

Will SRF use increase pollutants' release?



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Position of ECOS - European Environmental Citizens Organisation for Standardisation

CEN-Classification system of SRF

Classification based on ranges only for

1) net calorific value starts with 3 MJ/kg (ar)

2) mercury highest median is 0,5 mg/MJ

⇒ Waste with high water content is called fuel

⇒ Other heavy metals than mercury are not limited
(Cadmium to air, other heavy metals to ashes,
ashes are later incorporated into cement)

⇒ Content of pollutants is not restricted!

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Position of ECOS - European Environmental Citizens Organisation for Standardisation

ECOS conclusion on Solid Recovered Fuel production

- ECOS acknowledges that incineration of bio-mass contributes to climate protection (SRF: 30-60% bio)
- ECOS agrees that higher energy efficiency can be reached by SRF use in cement plants or energy plants compared to Municipal Waste Incinerators
- ECOS requires first before SRF production: establishing waste prevention and recycling systems
- But: waste with a **low net calorific value** or with a **high level of pollutants** shall not be used as "fuel"; prevention/recycling option are first

Thank you

for you attention

Email:

Tebert@oekopol.de

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2006-06-22
Position of ECOS - European Environmental Citizens Organisation for Standardisation

Opportunities with SRF: synergies between plastics waste and biomass

Presented by Neil Mayne *Plastics Europe*	PlasticsEurope Association of Plastics Manufacturers

- ~ 60 plastics raw materials manufacturers
- Represents more than 90% of all EU production
- Including converters the plastics value chain in Europe represent
  - 1.5 million employees
  - >160 billion €/year turnover

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Solid Recovered Fuels (SRF)

- Why promote SRF?
- Because they provide a local source of energy and help improve the environment

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Composition of SFR

- Why use mixtures of waste plastics and biomass?
- Because there are interesting synergies to be gained

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UTOPIA (not quite there)

- **Products fully satisfy needs of society (functionality, affordability)**
- **Production in economically feasible units with no harmful emissions**
- **A minimum of ultimate waste with no negative impacts**
- **All products made from renewable or fully recycled raw materials**
- **Use of products has minimal negative impact on the environment**
- **All energy renewable and generated efficiently**

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Life-cycle of plastics

1. Production of raw materials (feedstock + plastic)
2. Processing of plastics into products or components
3. Use of plastics article or component in a product (e.g. packaging, driving a car etc)
4. Treatment of the consumer product at end-of-life, to either recover materials / energy or ensure safe disposal

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Production and processing

- Almost all feedstocks are produced in efficient, integrated petrochemical complexes
- Continued innovation has ensured dramatic improvements in resource efficiency for plastics raw materials
- Processing technologies developed to use minimum of material, with more than 90% of production scrap being recycled (most plants have less then 2-3 % 'waste')

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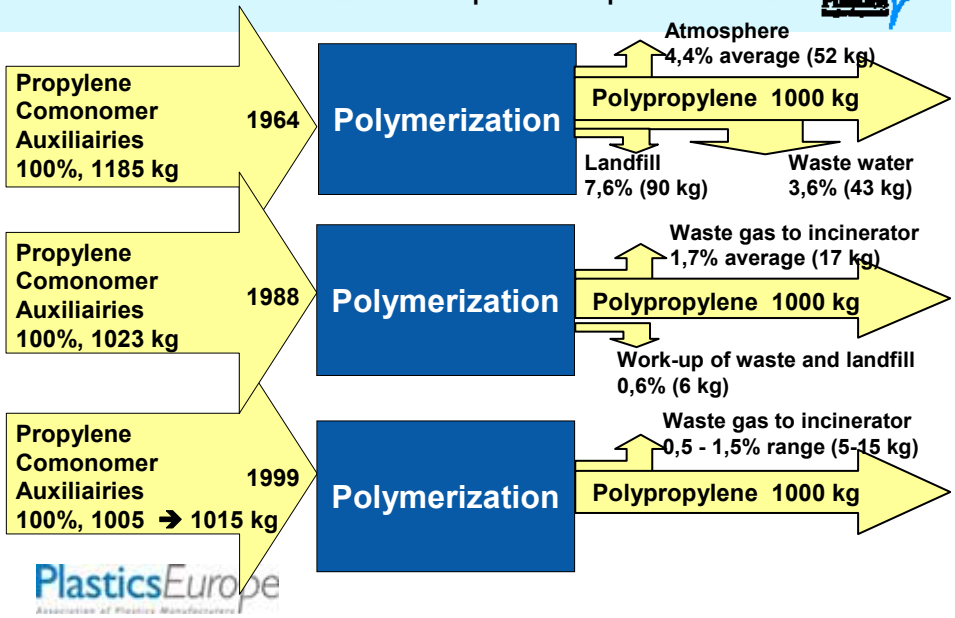
Resources and emissions - plastics production



Impacts of use phase of products

- Strongly influenced by behaviour of user (e.g. cars)
- The lightweight, insulating and durable properties of plastics are beneficial in numerous ways

  (An extensive study indicates substituting plastics in many existing applications would be counter-productive in term of energy use)
- Often lowest impact achieved by complex combination of different materials

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End-of-life impacts

- Waste phase of plastics offers significant potential for resource savings
- Extensive landfilling of E-o-L plastics means a valuable hydrocarbon resource is being wasted
- Depending on ability to sort into homogeneous streams of same type, discarded plastics can be recovered as either material (for recycling) or used as a source of feedstock and/or energy

Paper/pulp/biomass wastes have many similar characteristics to waste plastics

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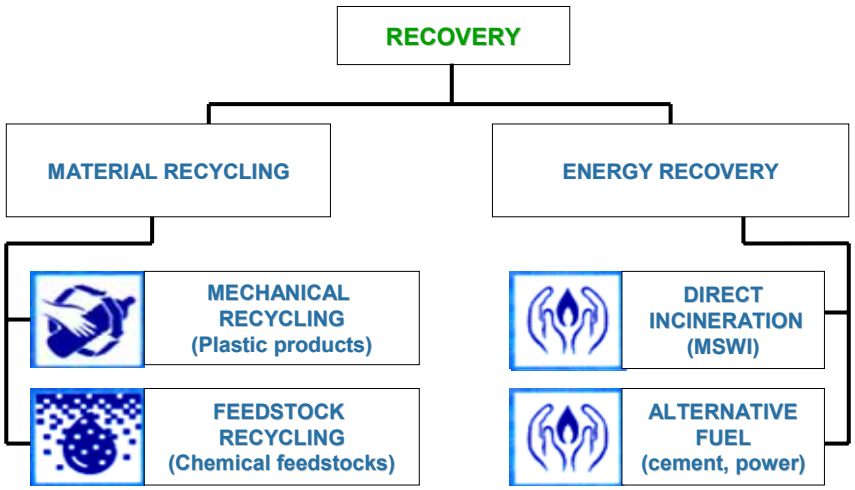
Options for plastics recovery



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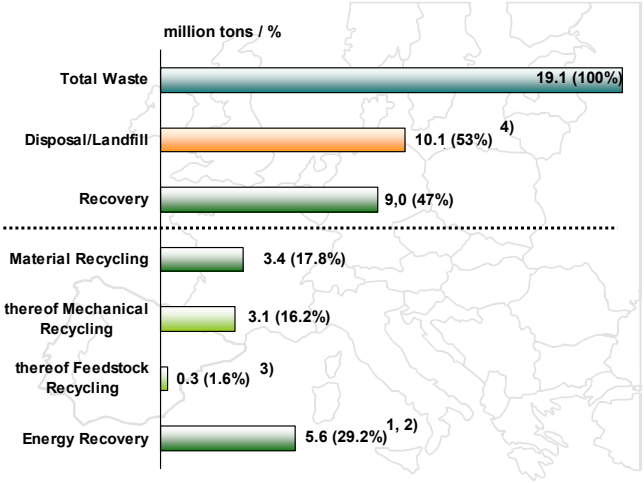
Post consumer plastics waste (W. Europe)
Estimates of waste treatments



- Total collected Plastics Waste 19.1 million tons
- Total Recovery: 47%
  - Mechanical R.: 16.2%
  - Feedstock R.: 1.6%
  - Energy R.: 29.2%

1) Thereof 92% MSWI and 8% others, e. g. Power Plants, cement kilns, waste derived fuel, etc.
2) Without IOW
3) Methanol Production / Reduction Process
4) Thereof ~99% landfill

Source: Plastics*Europe*, AJI-EUROPE & Consultic 2005

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Association of Plastics Manufacturers

Landfill is least preferred waste option

- High GHG emissions (food, green waste, paper)
- Waste of material resources (metals, plastics …)

⇨ Extent of recovery is main factor (recycling / composting, energy recovery)

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Association of Plastics Manufacturers

Energy & more from waste plastics

1. Energy savings from mechanical recycling of selected homogeneous plastics streams
2. Reducing agent in blast furnaces
3. Reducing agent in non-ferrous metal smelters for metal recovery from E&E products
4. Heat and power from municipal incineration
5. **Solid Recovered Fuels for power and various manufacturing industries**

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Biomass for energy developments

Ambitious energy from biomass targets in EU, with many challenges recognised:

- Priority for food production in EU25
- Biodiversity and nature conservation demands
- Potential for biomass waste for energy estimated at 100 million tonnes of oil equivalent in 2010 (source EEA)
- Advanced biomass conversion technologies assumed to be introduced

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Plastics can provide synergies..

- Not renewable, but up to 29% lower GHG emissions than from coal
- High calorific value materials (solid oil)
- Often co-mingled with paper waste so efficiency gains by no further unnecessary sorting of identified “energy streams”
- Around 10 million tonnes per annum plastics waste available which are currently landfilled

→ **An opportunity to increase local supplies of alternative energy**

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Proposed vision-SRF

- Sorting centres produce solid recovered fuel (SRF) streams of mixed plastic/biomass wastes
- EU wide classifications of SRF to encourage their trade and use
- SRF used extensively in various energy production technologies:
  - Direct co-combustion with solid fuels
  - In gasification step prior to combustion
  - Use in new, clean, efficient technologies (e.g. CCGT)

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Scenarios for SRF

- Stand-alone plants based on SRF from waste
- Co-feeding of industrial units based on fossil or biomass fuels (either directly or via pre-gasification step)
- Economic viability determined by costs of energy and alternative treatment available (e.g. MSWI, Landfill)

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R&D needs

- To establish optimum combustion / gasification characteristics of the major available SRF streams in EU, in relation to selected primary energy generation units
  - Pre-treatment
  - Feeding conditions
  - Technology adaptation
  - Bottom ash analyses – aiming for inert residues
- Guidance from relevant industrial stakeholders to identify appropriate energy generation technologies and to maximise prospects of implementation

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SWOT analysis: SRF-synergy

Strengths	Weaknesses
•Maximises local sources of energy and security of supply •Reduction of waste and less disposal to landfill	•Lack of sustained incentives for energy plants to invest in order to handle "waste" •Existing EU promotion of WTE has focus on biomass waste
Threats	**Opportunities**
•Exports of SRF outside EU hinders creation of extensive EU users market	•Creation strong SRF market •Adaptation of MSW sorting plants for "energy streams" alongside "recyclables" •A base for "clean energies"

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Conclusions

- Waste streams from plastics and biomass are both valuable local energy sources, which can contribute to security of energy supply
- Important synergies are possible in the production of solid recovered fuels using both sources together - which can lead to efficiency savings
- A need to establish combustion / gasification characteristics for use in various energy generation technologies
- Standards will help establish market

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Additional Slides

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Main results of study (GUA GmbH, Vienna, 2005)

- Total energy to produce, use and recover plastics in Western Europe is 3.900 Mill GJ/a
- Substitution of plastics where possible would need additional energy of 1.020 Mill GJ/a (+ 26%)
- Additional GHG emissions if plastics were substituted: 97 Mt/a or 56% more than in total life cycle of all plastic products today
- On average, 40 % of the total life cycle energy of products is linked to the USE-phase

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Results are equivalent to ...

- **1.020 Mill GJ/a additional energy needed for substitution of plastics is equivalent to**
  - 22,4 Mill tonnes of crude oil or 190 ultra large crude oil tankers (a row of 87 km of ultra large crude oil tankers)
  - primary fuel input of 10 nuclear power plants with 1.000 MW
  - heating and warm water for 40 Million people (half of Germany)
- **97 Mt/a additional CO_2 emissions are equiv. to**
  - 30% of the Kyoto reduction target for the EU-15 in the period 2000 – 2012 (319 Mt/a)
  - CO_2 emissions from 90% of private cars in Germany
  - all Germans driving 4-5 times per year to the Italian beach and back

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General hierarchy of recycling schemes for plastics

eco-profileProfitable / positive	Crates Commercial and distribution films
Some support needed / neutral or slightly positive eco-profile	PET bottles PVC window profiles Automotive bumpers PVC pipes EPS packaging Agricultural films HDPE bottles
Significant support through "Green dot" or other system / negative to neutral eco-profile	PS Coffee cups Mixed plastics

NB = Actual hierarchy will depend on local circumstances

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The potential of Solid Recovered Fuels and waste management in Central-Eastern Europe Countries

Presented by Hanna Burczy, Uszula Dabrowska, Tomasz Golec *Institute of Power Engineering* *Warsaw (Poland)*	

"The potential of Solid Recovery Fuels and waste management in Central – Eastern European Countries"

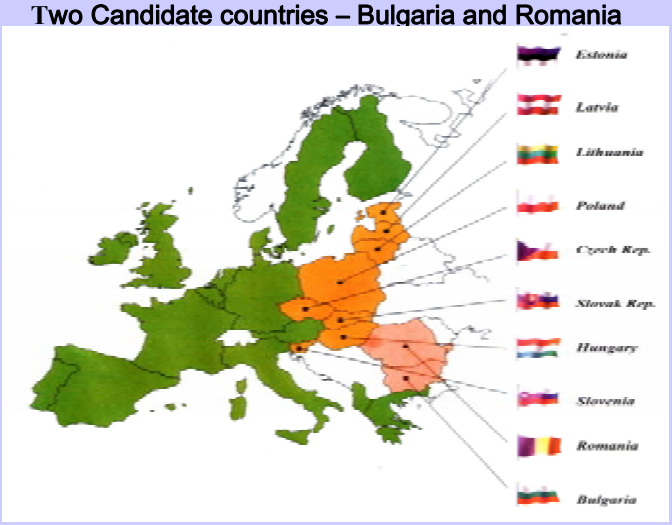
Hanna Burczy
Tomasz Golec
Urszula Dabrowska

Institute of Power Engineering
Warsaw (Poland)

„QUOVADIS – Workshop – Update of SRF data collection in Western Europe and New Member States EU"
June 22 , 2006 CYPRUS

1. THE CENTRAL EAST EUROPEAN REGION

Eight Newly Member States:
Two Candidate countries – Bulgaria and Romania



2. THE CENTRAL EAST EUROPEAN REGION CHARACTERISTIC

COUNTRIES IN THE REGION:

Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovakia and Slovenia.

- **Area of Region – 1077 th km2 4.7 % – EU 25**
- **Population – 104,6 mill. 14.4 % – EU 25**
- **Density of population – 97 inh/ km2**
- **GDP in USD- 95 per capita in 2000:**
  - **a) total - bill US$:**
  - **- in the CEE Region – 907**
  - **- in EU 15 – 8524**
  - **b)per capita – th US$:**
  - **- in the CEE Region – 8.67**
  - **- in EU 15 – 22.60**

3. KEY DATA OF THE CEE REGION IN 2000

Country	Total area [1000 km^2]	Population [million]	GDP (PPP) per capita [1000 US$ 95]
1. Bulgaria	111.0	8.17	6.05
2. Czech Republic	78.9	10.27	12.84
3. Estonia	45.2	1.37	8.39
4. Hungary	93.0	10.21	11.12
5. Lithuania	65.3	3.70	6.84
6. Latvia	64.6	2.37	6.58
7. Poland	312.7	38.65	9.40
8. Romania	238.4	22.44	5.08
9. Slovak Republic	49.0	5.40	9.65
10. Slovenia	20.3	1.99	15.13

Sources: [1], [2].

„QUOVADIS – Workshop – Update of SRF data collection in Western Europe and New Member States EU" June 22 , 2006 CYPRUS

4. PRIMARY ENERGY PRODUCTION, NET IMPORT AND CONSUMPTION IN THE CEE REGION – YEAR 2000

Country	Primary energy production [Mtoe]	Net imports [Mtoe]	Primary energy consumption [Mtoe]
1. Bulgaria	10.0	8.7	18.8
2. Czech Republic	29.9	9.4	40.4
3. Estonia	2.9	1.7	4.5
4. Hungary	11.3	13.9	25.0
5. Lithuania	3.2	4.2	7.2
6. Latvia	1.3	2.3	3.6
7. Poland	79.6	9.7	89.9
8. Romania	28.3	7.8	36.3
9. Slovak Republic	6.0	11.6	17.5
10. Slovenia	3.1	3.5	6.5
Region	**175,6**	**72,8**	**249,7**

Sources: [1],[2].

5. CENERG's EXPERTS FOR ASSESSMENT OF SRF IN THE NEWLY MEMBERS STATES

- **MSc Ladislav Pazdera from Ministry of Industry and Trade from Czech Republic - responsibility for data collection for Czech Republic and Slovak Republic.**
- **Dr. Vaclovas Kveselis from Lithuanian Energy Institute - responsibility for Baltic Countries – Lithuania, Latvia and Estonia**
- **MSc. Temenuga Manoilova from Energoproyect - responsibility for South European countries ie. Bulgaria, Hungary and Romania.**
- **CENERG - responsible for data collection on Poland and co-ordination the experts activity.**

6. WASTE MANAGEMENT IN BALTIC STATES

The Baltic States are three countries: Estonia, Latvia and Lithuania

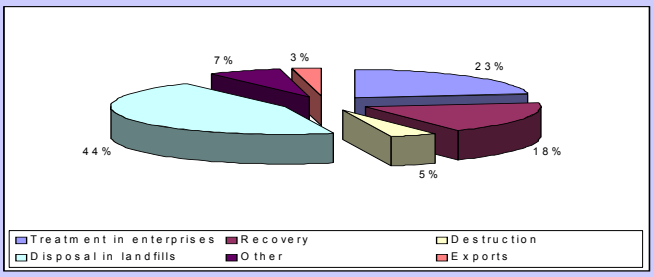
	Estonia	Latvia	Lithuania
Area	45,226 sq. km	64,100 sq. km	65,200 sq. km
Population	1.354 million	2.32 million	3.454 million
Forest area	31%	39%	16.3%
Household waste generating	380 kg/ca	280 kg/ca	350 kg/ca

- **The Baltic economies are predicted to continue growing at a high annual rate of 5-10% until at least 2010**
- **Fast growth of economies has an impact to fast growth of waste generation in future and expenses for waste management and treatment.**

7. WASTE GENERATION AND TREATMENT IN ESTONIA

The total of waste generated in Estonia in 2000 - 11.6 million t, including:

- **11.0 million tons of industrial waste, (95%)**
  including about 6,0 million tons of hazardous waste,
- **0.6 million tons of municipal waste (5 %).**
- **In the last decade industrial waste were decreasing**
- **In Estonia, the waste of oil shale industry, such as slag, fly ash, semi-coke and gangue are the biggest part in total waste flow (85% in 1999).**



8. MUNICIPAL SOLID WASTE IN ESTONIA

567 th. t of municipal waste in 2003 forms approximately 4-5 %
of the total amount of waste.

- **1999 - 393 kg/a per person and slightly reduced in the year**
- **2003 – 380 kg/a per person.**

Almost all waste is disposed without sorting to landfills
– about 351 landfills
- 10 incineration for non hazardous waste,
- 7 incineration for hazardous waste - 3000 tonnes was incinerated (less than 0,1 %) with energy recovery.
Environmental targets – recovery rate for waste of 50%

Estonian working landfills

9. WASTE GENERATION LATVIA

In 2001 in Latvia generated of:
- 1 200 th. tons of waste which:
- over 500 th. tons industrial waste
- over 80 th. tons of hazardous waste
- 600 - 700 thousand ton of municipal waste.

The majority of collected municipal waste and other types of waste is buried in dumpsites without pre-treatment.
40 % of collected waste is buried at the Getliņi landfill site situated in the Riga district.

- **341 landfills is in operation**
- **10 to 12 new regional landfill sites for municipal waste and appropriate waste treatment installations are to be established**
- **the current dump sites are to be closed and re-cultivated.**
- **Packaging waste, the amount of which is increasing in Latvia over the past years, composes nearly 20% of waste.**

10. WASTE POLICY TARGETS IN LATVIA

Policy goals are:

- to limit waste production and to reduce quantities of buried waste by promoting to processing or reuse,
- to implement a regional municipal waste management system,
- to provide for the burying of waste in a way that is safe for human health and the environment,
- to facilitate waste processing as close to its place of origin as possible,
- to facilitate the introduction of sorted waste collection system in municipalities,
- to ensure the availability of services of a centralized household waste management system to all residents.
- to encourage the sustainable development of re-cultivated dump areas.

11. WASTE GENERATED IN LITHUANIA

In 2001 in Llithuania generated of:

- 5 million tonnes of waste which:

- 4 million tonnes industrial waste

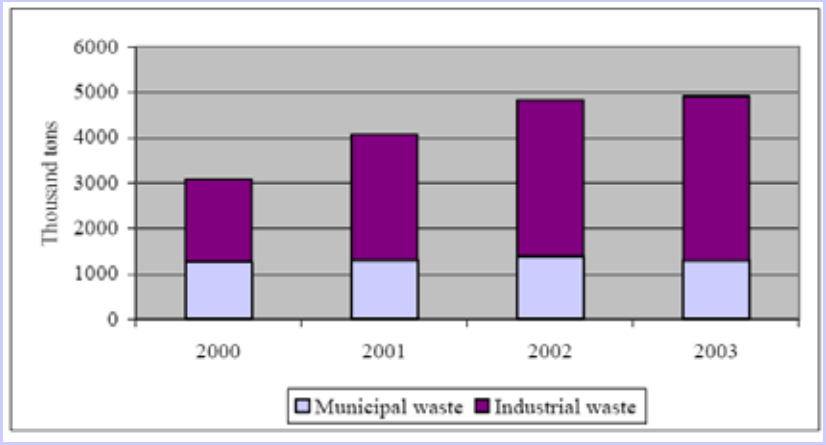
- 100 th. tonnes of hazardous waste (32 kg per capita)

- 1 million tonnes of municipal waste.

Industrial waste constitutes a large part of all waste (80%). Most of this waste must be treated using specific technologies.

- Annually an amount of 300 kg per inhabitant is generated in large cities, about 220 kg – in smaller towns, about 70 kg – in settlements.
- 300 landfills in operations
- Incineration – about 250 th. tonnes in 2003
- The amounts of incinerated municipal - up to 500 tons.

12. WASTE GENERATED IN LITHUANIA



13. WASTE MANAGEMENT PRIORITIES IN LITHUANIA

- **Establishment and operation of the regional waste management systems complying with the requirements of the EU and Lithuanian legislation**
- **Ensuring minimal negative impact to environment, rational recycling and energy recovery**
- **Minimization of disposed of biodegradable wastes (composting and energy recovery)**
- **Implement source-based municipal waste sorting**
- **Construction of dump site for radioactive wastes.**

14. TOTAL WASTE GENERATED IN POLAND

The total of waste generated in Poland in 2003 included:

- **120,551 th. t of industrial waste, (92 %)**
  - 1,339 th. t of hazardous waste,
- **9 926 th. t of municipal waste (8 %). (260 kg per hab.)**

More than 70% of waste is generated and stored in the three southern Parts.

The smallest volume of waste is generated in the north- east part - less than 1% of total waste stream.

There is only one incineration plant in Poland. It is operated by the Municipal Solid Waste Disposal Plant.

Incinerator processes thermally approximately 50 thousand tons of waste annually.

15. INDUSTRIAL WASTE IN POLAND

Due to economic reforms the amount of waste generated by the industrial sector in 1990 – 2003 was gradually decreasing, Polish entities generated:

In 1990 - 143,9 million tons of industrial waste
- 77,1 millon tons of which were recovered (54%)
In 2000 - 125,5 million tons of industrial waste:
- 96,5 million tons (76.9%) of which was recovered,
In 2003 - 120,6 million tons of industrial waste:
- 95,4 million tons (79.1%) of which was recovered,
- 21,7 million tons (18 %) was landfilled,
- 3,9 million tons (3.1%) was stored.

Over 50% of the recovered materials was used as a secondary raw material for industrial purposes, construction etc.

16. SOURCE INDUSTRIAL WASTE

In 2000 the biggest volume of waste was generated by the following industry:

- **The mining industry – 73 569 thousand tons, about 58,6% of all waste generated, (82% was recovered)**
- **Fuel and power industry – 19 741 th. t (16,9%),**
- **Agricultural and food industry – 10 631 th. t (8,6%),**
- **Metallurgical industry – 7 794 th. t (6,3%),**
- **Wood, cellulose and paper industry – 5 653 th. t (4,6 %), 87% were recovered,**
- **Chemical industry – 3 618 th. t (2,9%), 29,2% was recovered,**
- **Repair and construction industry – 2 186 th. t (1,8%),**
- **Leather and textile industry – 132 th. t (0,1%) .**

17. GENERATION OF MUNICIPAL SOLID WASTE

The municipal sector generated in 2003 tons of 9924,8 th. tonnes of municipal solid waste.

About 97% of the municipal solid waste was deposited at municipal landfills by the entities involved in waste collection and transport.

- **1049 registered municipal landfills (1098 in 2002), with the total area of 3125 ha.**
- **Due to a selective waste collection approximately 148,000 tons of waste paper, glass, plastics, and metals was collected separately, which constitutes approximately 1,2% of the total generated municipal waste.**
- **There are more than 50 sorting establishments active in Poland;**
- **52 recovery facilities, where the initially separated waste is prepared for the recovery process.**
- **54 establishments of waste composting.**

18. LAW ASPECTS OF WASTE MANAGEMENT IN POLAND

A number of primary and secondary legislative acts constitute the legal framework for waste management in Poland.

•Environmental Protection Act of 27.4.2001, Dz.U.2001, No 62, item 627 (entered into force in October 2001)

• Act on Waste of 27.4.2001, Dz.U. 2001, No 62, item 628 (entered into force in October 2001)

•Act 11.05.2001 on packaging and packaging waste

•Regulation of the Minister of the Environment of 7.9.2001 on the catalogue of wastes, Dz.U. 2001, No 112, item 1206

• Regulation of the Minister of the Environment of .12.2001 on the scope of information supplied at registration by owners of wastes excluded from the obligation of obtaining permits and methods of registration, Dz.U. 2001,No 152, item 1734

•Regulation of the Minister of the Environment of 11.12.2001 on the types of wastes or quantities of wastes for which there is no obligation to record wastes and categories of small and medium-sized enterprises which may use simplified records of wastes, Dz.U. 2001, No 152, item 1735

19. WASTE GENERATION IN CZECH REPUBLIK

Total waste generated in Czech Republik in 2002 was 38 643 th. tons :

- **33 900 th. of industrial waste,**
  - including 9601 th. t of manufacturing industry
  - including 2409 th. tons of hazardous waste,
- **597 th. tons of mining waste**
- **4 747 th tons of municipal waste (12 %). (465 kg per hab.)**
  - of which more than 70% are landfilled.
  - 5% is incinerated in 3 energy generating incinerators (Brno, Liberec, Prague).
  Around 100 000 tonnes per year of used tyres appear in the Czech Republic.
  40 – 50% of this amount is collected and besides using as SRF in cement plants, they are used as construction material in building industry. Small amount (around 5%) of collected tyres are disposed in landfills.

20. WASTE GENERATION IN SLOVAK REPUBLIC

In 2000 total of waste generated in Slovak Rep. was 15 200 th. tons including:

- **13 700 th. of industrial waste, (90 %)**
  including 1600 th. tons of hazardous waste,
  - 73 % of manufacturing industry
  - 16% energy production
- **1500 - 1700 th tons of municipal waste (10 %). (319 kg per hab.)**
  - of which about 1200 th. tons 80 % are landfilled.

Large number of waste treatment and disposal plants were in operation in 2000.

- **For non-hazardous waste there are 30 treatment plants, two incinerators and 100 landfills available,**
- **For hazardous waste there are 20 treatment plants, 65 incineration plants and 41 landfill sites available.**
- **The number of operating landfill sites is expected to decrease significantly by 97 until 2008.**
- **Currently only 14 of 67 existing incineration facilities comply with emission limits stipulated by Decision 2000/76/EC.**

21. WASTE GENERATION IN BULGARIA

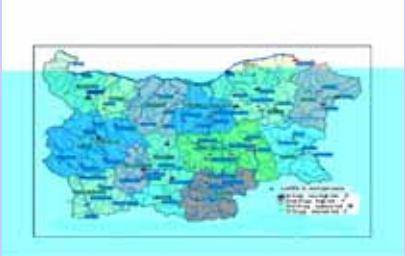
The waste generated in 2001 included:

- **8184 th tonnes of industrial non-hazardous,**
- **7426 th. t of which was landfilled**
- **349 th. tons delivered for recycling, (4,3% of the total generated quantity)**
- **4003 th. tons of municipal,**

- **84 landfills for industrial non-hazardous waste are identified including (74 in operation and 10 closed).**
- **There are 29 facilities with hydro-transportation of waste in energetic, chemical industry, construction industry, metallurgy and food industry.**

22. MUNICIPAL WASTE IN BULGARIA

- **4003 th. tonnes of municipal about 505 *kg/inh./year***
- **-of which landfilled - 3198 th. tonnes**
- 59 of these landfills serve the settlements with population above, 20000, which corresponds to approximately 70% of the population of the country. (only 2 with minimal risk)
- Installations for incineration are constructed in some of the bigger hospitals serving the regional centres of the country.
- These facilities as a whole do not fulfil the requirements for minimal temperature of incineration and for residence time of the combustion air and they are not equipped with the necessary pollution abatement equipment.
- The second main group of installations for incineration of waste are located at the main airports in Sofia, Burgas and Varna and at the ports in the later two towns.



23. PRIORITY FOR SEPARATE COLLECTION AND RECYCLING

- **Packaging waste and other similar municipal waste suitable for recycling (waste paper and paperboard, plastics, metals etc.);**
- **Wastes form offices, administrative buildings and establishments;**
- **Biodegradable waste from households and the catering establishments;**
- **Bulky waste;**
- **Construction and demolition waste;**
- **Used tyres;**
- **End-of-life vehicles.**
- **The authorised institutions have to organized information campaigns for the potential possibilities and benefits of waste recycling and recovery.**
- **Increase of the quantity of the energy recovered during waste incineration**
- **Discussed the advantages and disadvantages of the waste incineration with energy recovery**

24. WASTE GENERATION IN HUNGARY

- The total of waste generated in 2000 included
- 4.6 million tons of solid municipal waste; (2/3 of it originating from Households, while the 1/3 came from institutions, Services and Industry)
- Treated Municipal liquid waste – 20 mill. tonnes
- 45 – 55 millions tons of industrial agricultural and other economic activity
- About 5% of the above mentioned quantity was hazardous waste, .
- The typical treatment of generated waste is disposal, mostly into landfills - 85% of collected waste
- Thermal waste disposal amounts to some 6%
- 2 700 landfills are operating, but only 1/3 of them meet basic environmental standards
- In 2000 - 30% of the non- hazardous waste and 20% of hazardous waste were recycled in the industry.
- More than 1 000 landfills must be shut down.

25. WASTE MANAGEMENT IN HUNGARY

The waste situation in Hungary seems to be significantly and structurally different from the EU countries with:

· Smaller proportion of municipal wastes among total wastes generated;

· Significantly smaller proportion of reuse and recycling, except in hazardous wastes;

· Significantly smaller proportion of incineration than the EU average.

- The rate of recycling for municipal solid waste in Hungary is 3% compared to the EU average 15%.
- 3% - the industrial hazardous waste was incinerating
- Dorog - incinerators with a capacity of 25 000 tons/year,
- In 1998 only 8 % of the municipal solid waste was incinerated,
- The Budapest Waste Treatment Plant - municipal waste incinerator. This plant takes care of the disposal of over the half of municipal waste produced in the capital.

The incineration rate at the industrial non hazardous waste - around 0.1 %.

26. WASTE MANAGEMENTS TARGETS IN HUNGARY

- The waste management targets are:

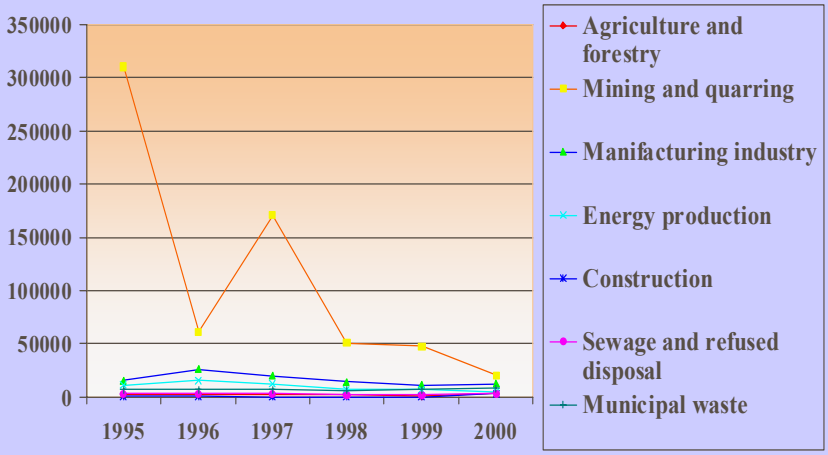
- Prevention: At the end of 2008 the generated waste mass will not exceed the level of 2000;
- Recovery: 50 % recovery rate for packaging waste till 2007 and 50% reduction of landfilled quantity of biodegradable waste till 2007;
- Incineration: The old waste incinerators will be renovated or closed;
- Landfill: Revision and liquidation of the old landfill sites till 2009.

27. WASTE GENERATION IN ROMANIA

- In 2000 in Romania generated 53 million tonnes of waste
  - 45 million tonnes of industrial waste (85%)
  - 8 millions tonnes of municipal waste (15% of generated total)
- Thermal power plants in Romania use mostly coal as an energy source, which results in the generation of huge quantities of ash and slag.

- Industrial activities that have generated (in 2002) the largest amounts of waste, excepting mining industry, are the following:
- Power industry 11.7 x 10^6 tons;
- Metallurgy 4.8 x 10^6 tons;
- Food industry 1.2 x 10^6 tons;
- Chemical and petrochemical industry 1.1 x 10^6
- Almost all municipal waste is disposed at landfill sites.
- There is more than 1 250 landfill site for municipal and industrial waste.

WASTE GENERATION by SECTORS of ECONOMY, in ROMANIA, 10^3 t



29. WASTE MANAGEMENT STRATEGY

In Romania, the priorities in the waste management field are defined and established within the National Waste Management Strategy, elaborated in 2003:

- **waste producing prevention;**
- **waste recycling and reuse;**
- **material recovery from waste;**
- **thermal recovery from waste;**
- **controlled landfill of waste, ensuring constructions standards and the control systems required in order to substantially reduce the negative impact on the environment;**

- **The Strategy and the The National Waste Management Plan - were approved by Governmental Decision 1470/2004 published in the official Journal 954 of October 18th 2004;**

30. WASTE GENERATION IN SLOVENIA

The total of waste generated in Slovenia was 5 800 th. tons Including :

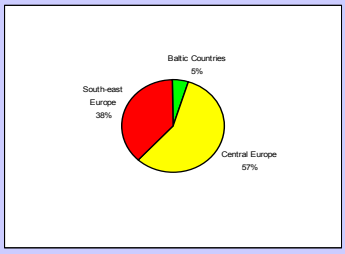
- **4 900 th. of industrial waste, (84 %)**
  including 67 490 tonnes tons of hazardous waste,
- **900 th tons of municipal waste (16 %). (550 kg per hab.)**
  of which about 690 th. thonnes 77 % are landfilled.
- **Waste management methods are still dominated by landfilling - 51 active landfills for municipal waste and similar non-hazardous waste**
- **10 industrial landfills are currently in operation.**
- **8 incinerators - have obtained licenses for the incineration of waste.**
- **Two of the facilities are licensed as waste incinerators for thermal treatment of hazardous waste.**
- **The other five facilitates are using waste as fuel**
- **The waste incineration plants for municipal and similar wastes has been discussed for years, but is still hampered by strong opposition among the population.**
- **The collection of secondary raw materials for recycling has a relatively long tradition and has been quite successful .**

31. WASTE GENERATION IN CEE COUNTRIES REGION

Industrial waste generation

- **Baltic Countries- 16 mill. t**
- **Central E.Countries - 170 mill. t**
- **South–east E. Countries - 115 mill.t**

CEE Region 300 million ton

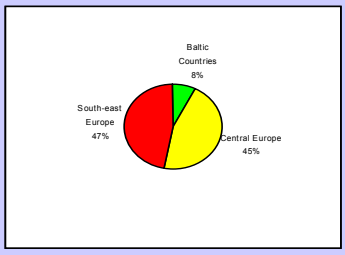


Municipal Waste Generated

- **Baltic Countries - 2,5 mill. t**
- **Central E.Countries - 17 mill.t**
- **South–east E.Countries - 18 mill.t**

CEE Region 38 million ton

Population – 104,6 mill.

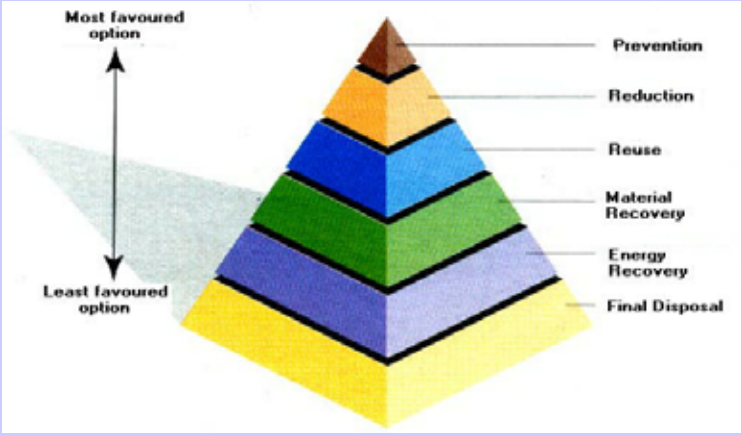


32. CONCLUSIONS

- The potential of SRF will grow in CEE Region
- Implementation of EU Directives expands possibilities of SRF use in the industry and energy sectors
- High prices for energy resources will force a review of waste and energy strategies, benefiting energy recovery projects
- Fast economic growth suggests growth of waste generation in future
- Adoption of EU Directives in national legislation has changed the perception of waste management and environmental issues in the CEE Region
- Main waste managements priorities

  - Minimization of the natural environmental degradation
  - Promotion of renewable energy utilization and environmentally friendly technologies, to avoid and minimize waste generation
  - Increase the share of industrial waste, recoverable and reused in the production process.

CONCLUSIONS cont.
HIERARCHY OF WASTE MANAGEMENT



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Role and requirements of coal-fired power plants in a sustainable waste management system

Presented by Joerg Maier *Institute of Process Engineering and Power Plant Technology, University of Stuttgart*	Universität Stuttgart

Institute of Process Engineering and Power Plant Technology

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Role and requirements of coal-fired power plants in a sustainable waste management system

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Perspective on Waste and Power Production in Europe

European perspective

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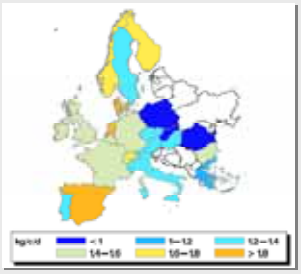
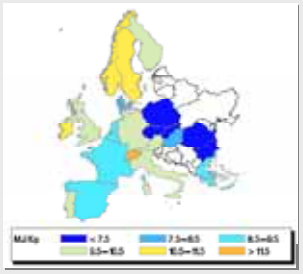
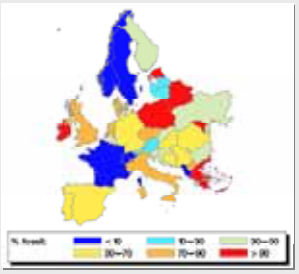


Average generation of MSW, kg/cap/d (UPSWING, 2004)



Average NCV of MSW in Europe, MJ/kg (UPSWING, 2004)



Fraction of fossil fuel in power production in Europe (UPSWING, 2004)

An enormous potential can be determined in Eastern and Southern European Countries *

* of course the power plants have to meet European demands

Most important treatment and disposal routes for MSW

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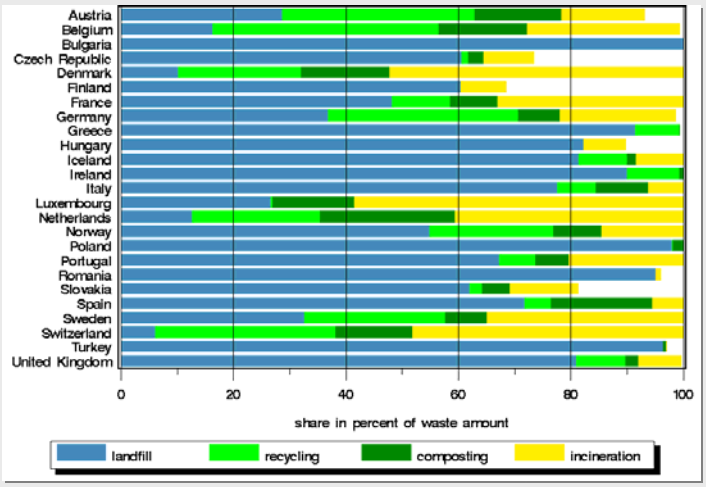

Most important treatment and disposal routes for MSW in Europe (UPSWING, 2004)

Coal-Fired Power Sector in Europe

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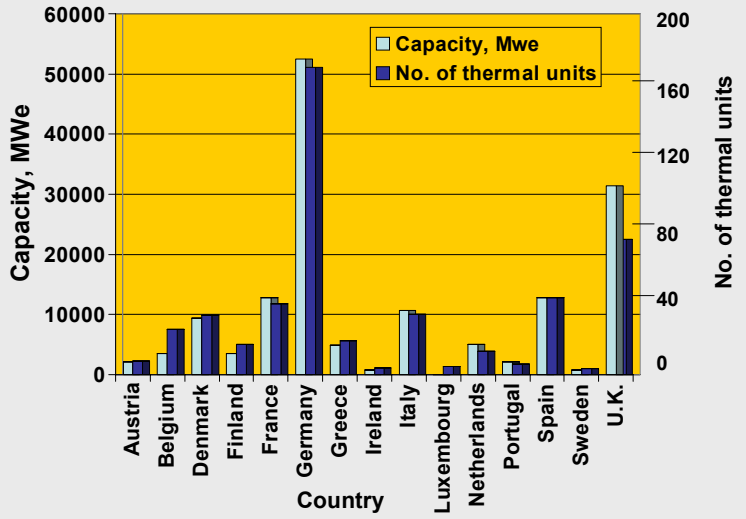

Coal-Fired Power Sector in Europe

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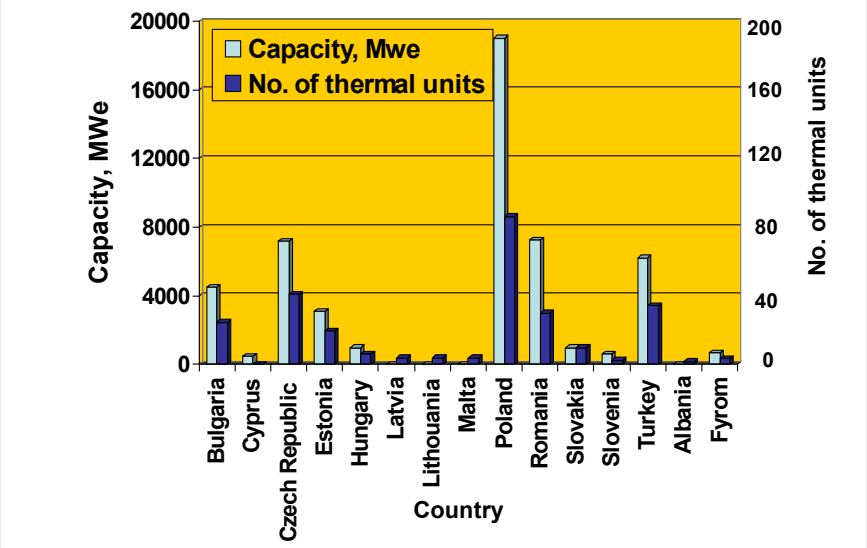

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Brown coal qualities in Europe

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Coal Sample	Moisture raw [%]	Ash raw [%]	Calorific Value raw [MJ/kg]	Volatile daf [%]	Carbon daf [%]	Hydrogen daf [%]	Nitrogen daf [%]	Sulfur daf [%]	Oxygen daf [%]
Ptolemais (GR) Sample 1	48.2	16.5	7.83	64.4	64	4.42	1.95	2.33	27.31
Ptolemais (GR) Sample 2	45.5	17.1	6.69	63.5	65.5	5.15	1.88	1.66	25.82
Mariza East (BG)	43.1	28.4	5.87	67.5	60.5	6.48	0.73	7.1	25.8
Pesteana (RO)	34.4	22.1	10.14	64.7	67.1	5.28	1.8	3.05	22.82
Rhenish (DE)	44.8	2.7	11.91	57.6	67.9	5.3	0.79	0.32	25.65

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Use of SRF in Energy Production

Why bother with new fuels in combustion?

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- **waste disposal on landfills will be limited**
- **use of thermal energy in waste ⇒ CO_2-reduction**
- **liberalization of market ⇒ costs**

Reasons for co-combustion

- low investment costs (existing firing systems)
- low impact on system at low heat ratios
- high efficiency of energy recovery
- fluctuations of recovered fuel supply can be encountered (supplemental fuel / primary fuel ratio)
- large capacities are available in short time
- easier permit process

Demand for process-qualified solid recovered fuels

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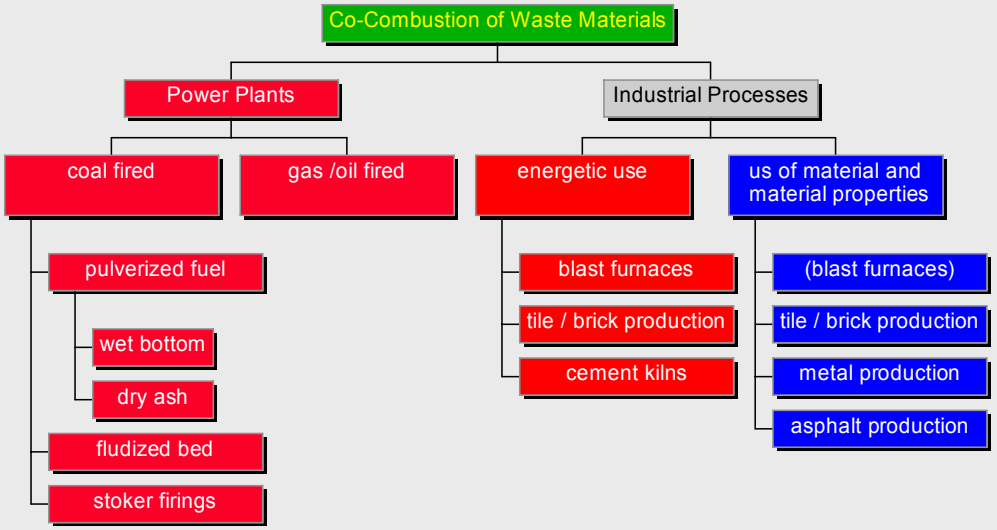

Direct and indiresct Co-combstion

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Fuel feeding and pre-treatment: Concepts

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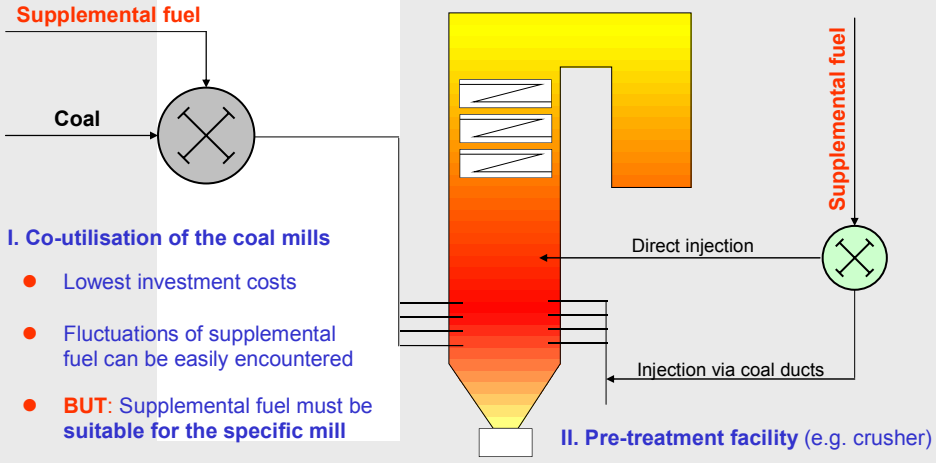
- Direct co-combustion requires adequate fuel pre-treatment of a possible supplemental fuel (particle burnout has to be secured)



I. Co-utilisation of the coal mills

- Lowest investment costs
- Fluctuations of supplemental fuel can be easily encountered
- **BUT**: Supplemental fuel must be **suitable for the specific mill**

II. Pre-treatment facility (e.g. crusher)

Co-utilisation of the coal mills: Areas of concern

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- **Mill capacity**
  - Increased volume due to lower density of the additional fuel
- **Mill wear**
  - Unwanted impurities in the supplemental fuel (e.g. scrap metals)
  - Different ash content of the supplemental fuel
- **Possible effects on mill performance**
  - Bridging of particles may lead to higher energy consumption of the mill
  - Adaptation of the sifter settings may be necessary to guarantee mass flow in the mill
- **Possible effects on coal grinding quality**
  - **Changes in the usual particle size distribution of the coal**
  - Drying behaviour of the coal may be affected by the supplemental fuel

Direct Co-combustion via roller mill

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Enrichment by large SRF particles

No fouling on the rolls by SRF

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Operational aspects
Deposits, Corrosion, Fly Ash Quality

Fuel Quality (element analyses S, N, Cl (**waf**))

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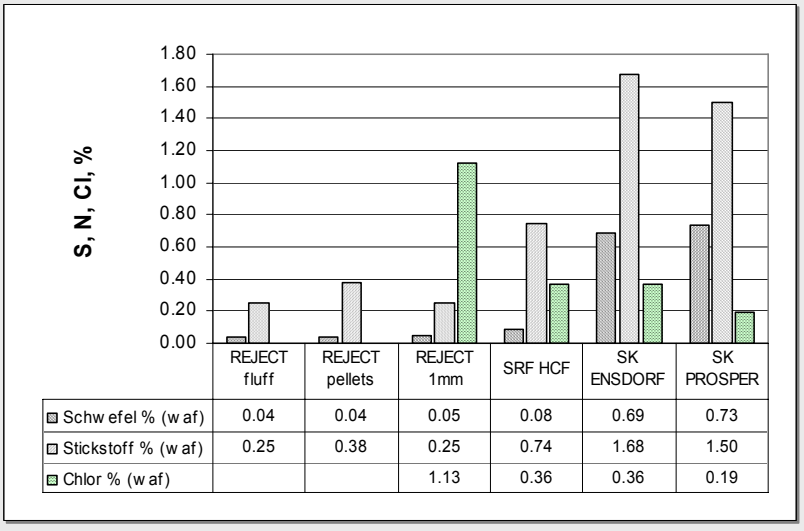

	REJECT fluff	REJECT pellets	REJECT 1mm	SRF HCF	SK ENSDORF	SK PROSPER
Schwefel % (waf)	0.04	0.04	0.05	0.08	0.69	0.73
Stickstoff % (waf)	0.25	0.38	0.25	0.74	1.68	1.50
Chlor % (waf)			1.13	0.36	0.36	0.19

Chlorid in fly ash by co-combustion with different bituminous coals

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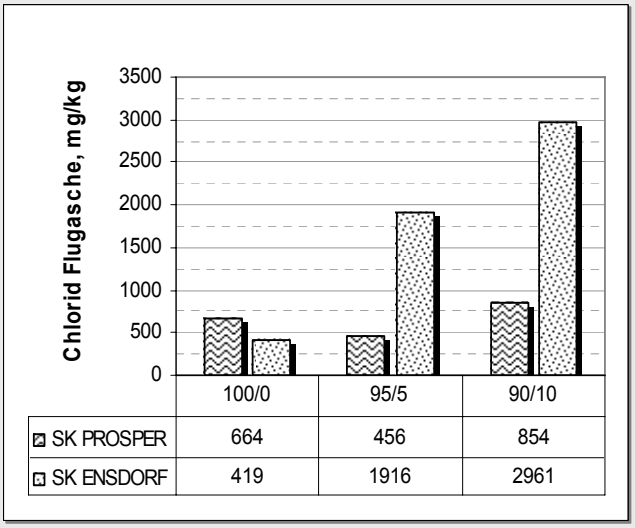

	100/0	95/5	90/10
SK PROSPER	664	456	854
SK ENSDORF	419	1916	2961

Deposits on water walls and superheater bondels

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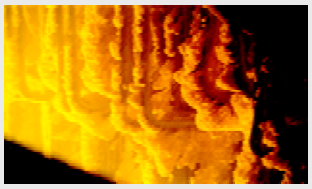

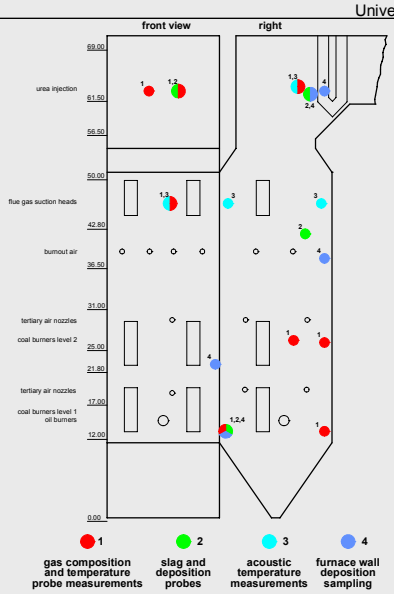

Corrosion (2): after 24h exposure, 13CrMo44

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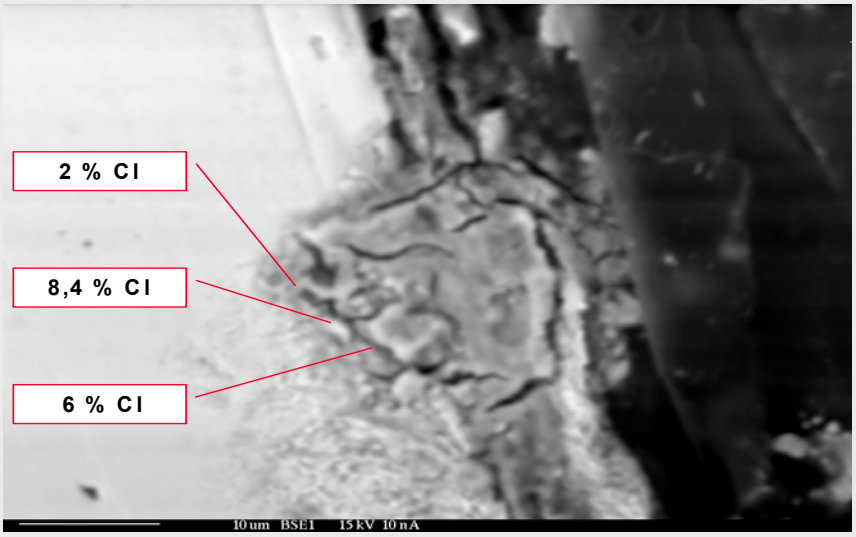

Fly ash quality according to EN-450

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Tabelle 1: Critical combination

Parameter	Einheit	ENS_100/0	ENS_95/5	ENS_90/10	Grenzwert
Glühverlust	%	4.2	(10.1)	2.0	A (<5%), B (2-7%), C (4-9%)
$SiO_2 + Al_2O_3 + Fe_2O_3$	%	79.8	77.3	74.6	> 70%
Chlorid	%	0.04	0.19	0.29	< 0.1%
SO_3 *	%	2.8	3.8	4.2	< 3%
Freikalk	%	1.22	(0.34)	1.28	< 1% (< 2.5%**)
Alkalien als Na_2O	%	2.4	3.0	2.5	< 5%

Tabelle 2: no ristrictions

Parameter	Einheit	PROS_100/0	PROS_95/5	PROS_90/10	Grenzwert
Glühverlust	%	15.0	13.9	13.2	A (<5%), B (2-7%), C (4-9%)
$SiO_2 + Al_2O_3 + Fe_2O_3$	%	77.9	81.3	80.9	> 70%
Chlorid	%	0.07	0.05	0.09	< 0.1%
SO_3	%	3.0	2.6	2.9	< 3%
Freikalk *	%	0.41	(0.10)	0.33	< 1% (< 2.5%**)
Alkalien als Na_2O	%	3.1	3.7	3.3	< 5%

Summary

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SRF co-combustion in large-scale power plants offers

- an sustainable capacity in a future waste management concept
- a significant substitution potential for fossil resources *
- a potential „negative“ fuel price (for the plant operator)
- a significant CO_2 reduction potential *
- several, cheap fuel feeding options of existing boiler systems
- Safe operation requires an relaible fuel quality – CEN-TC 343

Use of SRF in an integrated waste management concept

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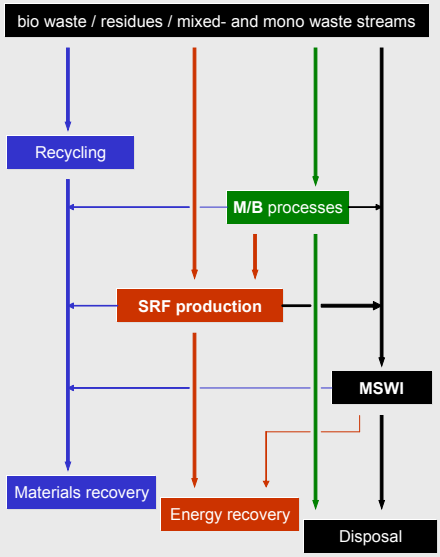

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Conclusions

Bernd M. Gawlik *– European Commission, Joint Research Centre, Institute for Environment and Sustainability*

G. Ciceri *– CESIricerche*

The workshop which was kindly coorganised with the Cyprus Ministry of Agriculture, Natural Resources and Environment was officially opened by the Director of the Environment Service, who read a welcome address of the minister. The workshop was followed by ca. 35 participants and was an excellent occasion to discuss the potential of co-incineration processes to solve specific waste management problems of some of the new member states. The following conclusions were made:

1.) The participants agreed that the production and use of Solid Recovered Fuels are a useful option in modern and sustainable waste management. However, it was emphasized that SRF use should be done in compliance with the general principles of modern waste management as established by the European Commission, which foresees above all a principle of waste avoidance and of material recovery. Only if these options are not viable, waste-to-fuel conversion should be envisaged.

2.) The development of CEN standards to describe the physico-chemical properties of solid-recovered fuels as undertaken by CEN TC 343 and the QUOVADIS Project are an important step to facilitate the use of SRF, with the final scope to replace fossil energy carriers such as lignite and coal by them and to avoid landfilling of non-hazardous waste. The discussion on classification of SRF in various classes is controversial but significant progress towards a position that can be shared between the various stakeholders has been made. The issue of the definition of a minimum caloric value as well as the boundaries of classes with respect to the mercury content and chlorine remains controversial. Nevertheless, it is generally accepted that standardized testing methods and sampling procedures are essential to provide comparable and reproducible data of known quality.

3.) With regard to the New Members of the European family, a first analysis on the potential of SRF has been presented to the audience. From this first compilation, it becomes obvious that there is a large potential for SRF in these countries. A serious obstacle, however, is that many installations in these countries that could potentially use SRF have major problems in meeting the requirements of waste incineration directive. Here SRF might be a possible contribution to improve the quality of emissions. In order to better evaluate this potential more information concerning technical features of the facilities concerned are needed.

4.) Cyprus officials are very much interested in the application of co-incineration based solutions provided that they lead to an improvement of the current situation and that this improvement can be conveyed to the local public. Although SRF technology is interesting, an additional factor has to be taken into consideration, i.e. the scale of the local economy (mainly SME based) and the size of the related waste streams. The latter are clearly an obstackle for recycyling solutions due to their limited size. Furthermore, due to its geographical position as well as to the still open “Cyprus question”, it is not feasible to combine the local waste streams with those of other countries on the continent. However, the option of an undifferentiated waste incineration is politically not viable.

5.) First contacts made between some project partners and the Cypriote scientists and regulators attending the workshop were very promising. Indeed, PlasticEurope expressed its interest in co-financing a co-incineration demonstration object. This option will be further investigated as a follow-up project of the workshop.

6.) Some participants emphasized that there are still large discrepancies in the environmental legislation in the various Member States and (future) New Member States, which should be overcome. For instance, participants from Bulgaria and Poland reported on difficulties in environmental legislation unification in respect to waste-to-fuel production. The need of informing the potential customers and the society in the New Member States and Acceding Countries on the subject of waste-to-fuel production was highlighted. The beneficial role of the QUOVADIS Project into this direction was explicitly underlined. In the same context it was criticized that the event did not attract more representatives from environmental authorities.

7.) Although the waste-to-fuel production and in particular the use of SRF is seen as a waste management option, some participants raised the point that this option is not explicitly considered in the Biomass Action Plan of the Commission. Many synergies are possible between renewable biomass resources and other waste in the production of SRF, (e.g. paper/plastic mixtures from municipal waste, as in the Sub-coal process in the Netherlands).

8.) All participants acknowledged the important potential role of the various JRC Institutes in the analysis of pros and cons of waste-to-fuel production. In particular, the JRCs important potential role in consensus building among the various stakeholders was outlined and acknowledged.

European Commission

EUR 22995 EN – Joint Research Centre
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Abstract
The present report is the collection of the proceedings of the workshop *Waste Management and Solid Recovered Fuel Potential in the Enlarged European Union* which took place in Larnaca (Cyprus) in June 20-23, 2006. The workshop was organized in the framework of the QUOVADIS project and was kindly coorganised with the Cyprus Ministry of Agriculture, Natural Resources and Environment. The workshop was followed by ca. 35 participants and was an excellent occasion to discuss the potential of co-incineration processes to solve specific waste management problems of some of the new member states.

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